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ABSTRACT

The need for planning in educational systems may be interpreted as the need to identify, prepare, and devise new or revised procedures through which explicit systemic goals may be realized. Usually such efforts have a specific time orientation. Planning is further related to policy in the sense that policy is a legitimized procedure or course of action. The logic suggests that planning should precede procedure specification and formal policy action. Computer simulation is a relatively new approach to the study and further understanding of complex entities and situations. The computer program is the embodiment of the real world event or entity of interest. Its primary advantage is the computer's capability of storing, manipulating, recombining, and reporting the past, current, and future states of numerous variables which together comprise the total behavior of a complex event or system. In this sense, the computer exceeds the intellectual capacity of the average person who would experience difficulty comprehending the totality of input variables, interaction effects, and current states of the system. (Author/WM)

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PROJECT KANSAS 76: CONCEPT PAPER

IMPROVED SCHOOL MANAGEMENT AND PLANNING:

THE PROMISE OF COMPUTER SIMLULATION

AN OCCASIONAL PAPER DEVELOPED BY THE PROJECT KANSAS 76 STAFF

July, 1973

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Project Kansas 76 is a cooperative effort to identify and develop new leadership skills and roles in Kansas education. Participating in the project, which is funded under Part D of the Education Professions Development Act, are the Kansas State Department of Education, Kansas State University, University of Kansas, Wichita State University, and the Wichita, Junction City, Manhattan, and Kansas City, Kansas school districts.

Major thrusts of the project include the cooperative assessment of educational needs in the three school systems, the identification of additional skills required by practitioners to meet these needs, and the possible suggestion of new types of leadership roles which seem feasible to satisfy identified needs and priorities. Programs will then be established to upgrade practitioner skills and to prepare people to fill new leadership roles which evolve.

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IMPROVED SCHOOL MANAGEMENT AND PLANNING:

THE PROMISE OF COMPUTER SIMULATION

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IMPROVED SCHOOL MANAGEMENT AND PLANNING: THE PROMISE OF COMPUTER SIMULATION

The last two decades of technological development have had a significant impact on public school education and on those individuals charged with the administration of our schools. So much so, that it would not be inappropriate to describe the changes that have occurred over just the past ten years as "explosive." Particularly is this true where the technology of computers and education are concerned and the specific juncture termed computer simulation.

Introduction

Historically, the incidence of educational data processing began in the late 1950's and by the early 1960's had gained considerable momentum on the part of public schools in terms of expressed desire to adopt or acquire computer capability. The period from the middle 1960's to the early 1970's provided an opportunity to adopt, test, and implement the more commonly accepted data processing applications. These would include: financial accounting, personnel information systems, student scheduling, inventory control, grade reporting, and numerous others now considered standard operations.

The past three or four years (1969-1973) have witnessed an

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increasing number of exploratory, developmental efforts in the educational sphere for which little prior experience exists as a guide for investigators. For example, current research efforts are directed toward the development and implementation of computer assisted instruction (CAI), computer managed instruction (CMI), management information systems (MIS), and the use of the computer in conjunction with sophisticated, quantitative techniques such as linear programming, input-output analysis, cost-effectiveness analysis, and applied decision techniques such as PERT and PPBS. Included among the foregoing is the field of computer simulation which is perhaps lesser known but with a growing audience of interested practitioners and an increasing number of investigators who are devoting their time and abilities to further development and exploration.

What Is Computer Simulation?

Commonly accepted usage of the term "simulation" varies considerably. However, for most purposes the term could be interpreted as "real world representation" without undue loss. In the sciences, physical models are widely recognized and readily accepted as representations (simulations) of real world phenomena. In the social and behavioral sciences, such models are more frequently found in the form of schematics or symbols (as in mathematical models). Unquestionably, simulations whether physical models, or symbol analogues, or more

role playing have added important dimensions to instructional methodology. Space exploration, military training, market and product analysis, and drivers training are just a few examples of the extensive use of simulation in training.

"Computer" simulation belies a methodological distinction and is a relatively new approach to the study and further understanding of complex entities and situations. The computer program is the embodiment of the real world event or entity of interest. Its primary advantage is the computer's capability of storing, manipulating, recombining, and reporting the past, current, and future states of numerous variables which together comprise the total behavior of a complex event or system. In this sense, the computer exceeds the intellectual capacity of the average person who would experience difficulty comprehending the totality of input variables, interaction effects, and current states of the system. Figure 1, suggests in a broad sense what takes place in computer simulation.

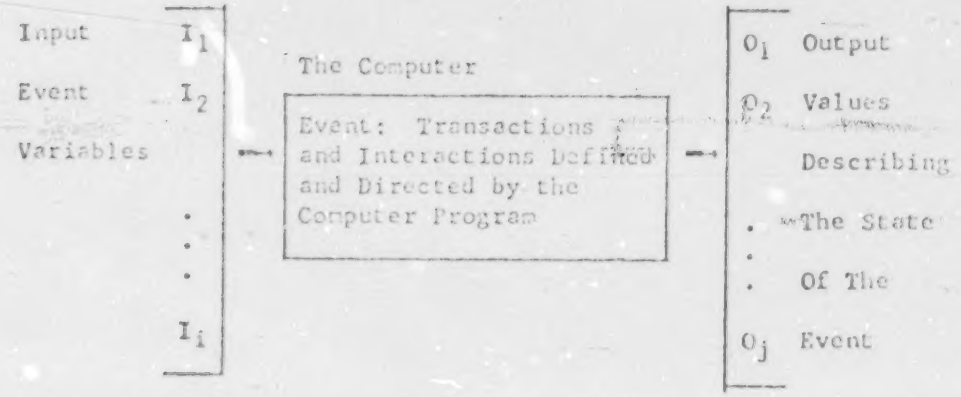

Fig. 1 Computer Simulation of a Real World Event

The process of developing a computer simulation of real world phenomena requires first a substantial understanding of the event, system, or phenomena to be simulated. Second, considerable information must be obtained which describes the qualitative and quantitative nature of the primary variables in the event which may easily exceed one hundred in number. Third, a careful study of the data in conjunction with in-depth knowledge of the system will begin to reveal a number of relationships among the primary variables which in turn are incorporated into the computer program. An iterative process of study, discovery, programming, testing, and modifying will usually result in a satisfactory simulation program. The criterion of success in computer simulation is the degree to which the output variables (response) are truly representative of parallel indices of behavior in the system of interest.

Implications for Management and Planning

The need for planning in educational systems may be interpreted as the need to identify, prepare or devise new or revised procedures through which explicit systemic goals may be realized. Usually such efforts have a specific time orientation. Planning is further related to policy in the sense that policy is a legitimized procedure or course of action. The logic suggests that planning ought to precede procedure specification and formal policy action, though this may not always be the case in practice. Planning has been

increasingly demanded in all organizations as a direct result of the increased tempo of change of which much has already been written.

Management, on the other hand, has numerous interpretations generally pertaining to the administration and control of social entities. The terms are related, in that planning is recognized as a necessary and legitimate function of management (Kaufman, 1972) which is requiring more time, more effort and an increasing share of organizational resources.

Planning, as a dimension of management, must concern itself with the stated goals of the system of interest, current levels of performance, future expectations, and the implications of continuing changes in both the external and internal environments of the organization. A critical appraisal of contemporary practice would reveal numerous faults in the current approach to planning in educational systems. Paramount among these are:

1. A failure to recognize the need for distinct, organizational units whose primary responsibility would be the planning function.
2. A failure to assign such responsibilities to a specific number of competent persons and the corresponding failure of institutions to train such individuals.
3. A lack of knowledge about the availability and relative merits of recent technological and methodological advances.

4. A failure to make planning information and assistance available to competing components in the system.
5. A failure to recognize and accept the complex, intractable nature of the forces and events of social systems and hence, the need for an improved technology with "wholistic" capability.

It is neither the purpose nor the intent of this paper to proclaim computer simulation as the "latest educational panacea" for all planning and management ills. A careful appraisal of the list, however, would reveal that if the criticisms are valid then the exploration of the potential of computer simulation as a technological tool is warranted. That is, the complexity and intractability of planning and managing of variables which comprise a wholistic approach to organizational enlightenment and development may well justify full exploration of any tool that exhibits even a modicum of future potential.

An Illustration

In a recently conducted study, an attempt was made to develop and test a computer simulation of the student population and teacher population components of a State Public School system. The essence of the study was to simulate the primary variables (births, deaths, drop-outs, migration, and institutional production, for example) and the intricate relationships that existed between primary variables as well as between the two components. The purpose of the study was twofold:

first, to gain greater understanding of the interactions that occur and second, to increase predictive efficiency for the purposes of five and ten year, advance planning. The third purpose was to begin testing various internal procedures for computer simulation and is of equal importance but of lesser interest here.

Some of the results of the study as evidenced by the simulated response of primary variables is both interesting and indicative of future potential. Table 1, compares the actual level of student populations with predicted levels obtained through simulation for a period of ten years.

Table 1. A Comparison of Simulation Response With a Time Series of Real World Values

Year	Actual Levels	Simulated Levels	Error (Units)	Error (%)
1965	1,968,403	2,040,940	+72,537	3.7%
1966	2,033,982	2,073,989	+40,007	1.9%
1967	2,079,961	2,102,964	+23,003	1.1%
1968	2,122,919	2,120,597	- 2,322	.1%
1969	2,164,386	2,124,507	-39,879	1.8%
1970	2,179,260	2,120,711	-58,549	2.7%
1971	***	2,105,291	***	***
1972	***	2,081,502	***	***
1973	***	2,051,520	***	***
1974	***	2,010,001	***	***

The table illustrates the predictive potential of computer simulation which employs birth data as an entering variable. Furthermore, the percent of error while seemingly large is tolerable for a number of purposes and satisfying as a "first effort" result.

A key assumption in the study is that the number of clients (students) in a client-service organization (public schools) is a prime prerequisite to systemic planning. Knowledge about expected client population levels is directly related to the expected need for professional staff, physical facilities, and financial support. To the extent that such knowledge is accurate and available, planning for future needs becomes enhanced and rational. Table 2, for example, illustrates teacher need predictions obtained by the same simulation program in comparison to actual teacher population levels and predictions obtained by two other forecasting methods; moving averages and exponential smoothing.

Table 2. A Comparison of Predicted Teacher Needs With Actual Population Levels: Three Methods

Year	Actual Levels	Simulation	Moving Averages	Exponential Smoothing
1959	58,251	55,857*	54,484	55,532
1960	60,394	59,405*	57,022	57,707
1961	63,271	63,362*	59,322	59,857
1962	66,024	68,002*	61,832	62,588
1963	68,099	72,521	64,647	65,387*
1964	69,380	75,432	67,061	67,557*
1965	72,935	77,121	68,739	69,015*
1966	76,047	78,974*	71,157	72,151
1967	80,637	80,599*	74,491	75,268
1968	85,346	81,589*	78,342	79,563

*Denotes most accurate estimate

An examination of the table will reveal that, on seven occasions out of ten, simulator generated predictions were more accurate than those obtained by alternate forecasting techniques. Thus, computer simulation performed satisfactorily as a technological tool in relation to other available tools and also revealed its potential for future planning tasks. Such potential might well be used, for example, to plan the number of entering trainees necessary to adequately staff the professional needs of schools five and ten years from today. At least, the vocational counseling function could be improved with more reliable, long-range information. Teacher preparation programs only require four years of preparation and hence only an accurate five year forecast of the net result of continuing present policy is needed. In this way we could avoid such over-production as is predicted by two available reports (NEA, 1970; USDL, 1970) which predict an over-supply of as many as 19,000 teachers per year for the next five year period.

Frequently, the needs of planning extend beyond simplistic point estimates. Appropriate routines can be incorporated in the computer program which will provide both point and interval projections and the interval limits can be constructed to reflect any desired span or tolerance. Additionally, important parameters can be varied to simulate the effects of alternate strategies or unusual conditions. The response information thus provided adds two additional dimensions: the first, is information important to selecting a particular alternative or strategy; and the second, is

a means of studying the complex effects of unusual conditions.

For example, one might readily question and study (via simulation) the impact of a ten year program of ten percent annual reductions in private school population levels. In a matter of a few hours, data could be available showing the impact of such an extreme factor on public school student levels and the demand and recovery of professional staff levels, physical facilities, and financial support formulas. Thus, computer simulation is a powerful, technological advance that promises to aid managers to fulfill the planning function in at least three ways:

1. Computer simulation programs will provide increasingly more accurate information about the predicted effects of current systemic forces.
2. Computer simulation programs can provide important "decision-making" information about the effect of alternate management strategies.
3. Computer simulation programs can provide opportunities to examine the consequences of unusual systemic forces or conditions over selected periods of time.

Simulation Guidelines

Simulation, at least in the sense of role-playing, is not new. Computer simulation, by comparison is a teenager. However, sufficient experience has been gained to assure practitioners that field trials are now in order. Particularly, is this true

in view of contemporary interest in planning, evaluation, and accountability and the real world experience of rapidly oscillating environmental forces. There is a need to regain and retain control over the effect of such forces and improved planning may be the key to becoming proactive instead of reactive. What then are the guidelines, if any, for such field trials?

First, immediate computer capability is not necessary since desired programs can be designed, developed, and tested at any available institution having the necessary expertise. Thus, any school district could initiate "field trials" independent of such a requirement.

Second, since much of the current development and testing now takes place at a few of the major institutions across the nation, it would be useful to let such efforts reside in those centers. The benefits would be at least two-fold: school districts (or any organization for that matter) would profit from continuing development and the necessary R&D expertise would not be duplicated resulting in unnecessary cost. This would apply to all but the larger school districts and organizations (50,000 students or more) who could justify the additional expense of staff and equipment.

Third, utilization of a new technological tool for planning assumes at least a minimal program of planning presently exists. Since planning is now recognized by an increasing number of schools as a legitimate and necessary function of management, it follows that more and more districts will begin to discover

the value of such a tool. Most organizations have used population projection for many years. However, many may not be aware of the intricate relationships between such estimates and other components of the system. Further, the numerous calculations required to examine but a few alternatives would discourage even the most dedicated manager or planning staff.

Finally, field trials must be initiated advisedly. It must be recognized that a period of time is yet necessary to achieve desired accuracy and reliability, and to further perfect existing techniques as well as develop new methods in response to suggestions originating from the field. Such enterprise, however, should be a cooperative effort. It would be well to plan a period of parallel operation where existing manual processes could operate with newly implemented computer programs. This would serve the purpose of providing an emergency operating system as well as providing a measurable criterion for acceptance and adoption.

To the extent that such field trials are successful both in terms of adoption and the further exploration and development of the potential of the tool, planning and management appear to be primary beneficiaries. Therefore it is incumbent upon managers to take the necessary steps to initiate a planning effort and to provide places and opportunities for the required field trials.

References

Blalock, Hubert M. Theory Construction: From Verbal To Mathematical Formulation. New Jersey: Prentice-Hall, Inc., 1969.

Culbertson, Jack. Computer-Based Simulation For Training Educational Decision-Makers. Project report for UCEA to the Ford Foundation, February, 1973.

Holloway, William H. Computer Simulation Of Aspects Of The Public Schools In Michigan Toward Applied Systems Analysis. A paper presented at the annual meeting of the American Educational Research Association in New Orleans, Louisiana, February, 1973.

Kaufman, Roger A. Educational System Planning. New Jersey: Prentice-Hall, Inc., 1972.

McNamara, James F. "Mathematical Programming Models in Educational Planning." Review of Educational Research, XLI, no. 5 (December, 1971), 419-40.

Nayler, Thomas H. (et al.). Computer Simulation Techniques. New York: John Wiley and Sons, Inc., 1966.

National Education Association (NEA). Teacher Supply and Demand in Public Schools, 1970. A published report of the NEA Research Division, 1970.

Stogdill, Ralph M. (Ed.). The Process of Model-Building in the Behavioral Sciences. Ohio: The Ohio State University Press, 1970.

United States Department of Labor (USDL). "Manpower Demand and Supply in Professional Occupations." A reprint from the 1970 Manpower Report of the President. Washington, D.C.: U.S. Government Printing Office, 1970.